Electricity – what is it?

- Electricity is a transfer of energy produced by the movement of electrons through a circuit.
- **ELECTRONS** have a **NEGATIVE** charge

Water Towers

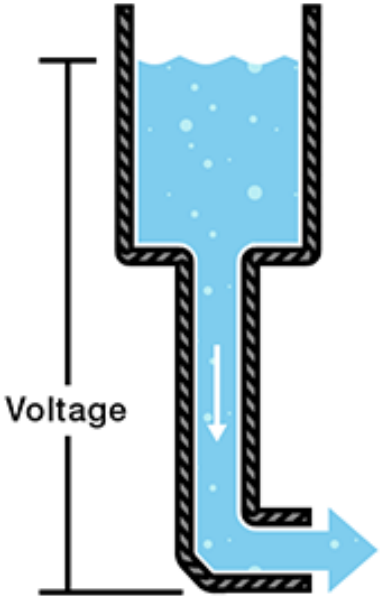
http://tackytraveller.blogspot.com/2010/03/florence-yall.html

Towers are filled by pumping water into it under high pressure.

Open the valve at the base, water will flow out of a hose at a high pressure.

The pressure at the end of the hose can represent voltage.

The more water in the tank, the more pressure is measured at the end of the hose.

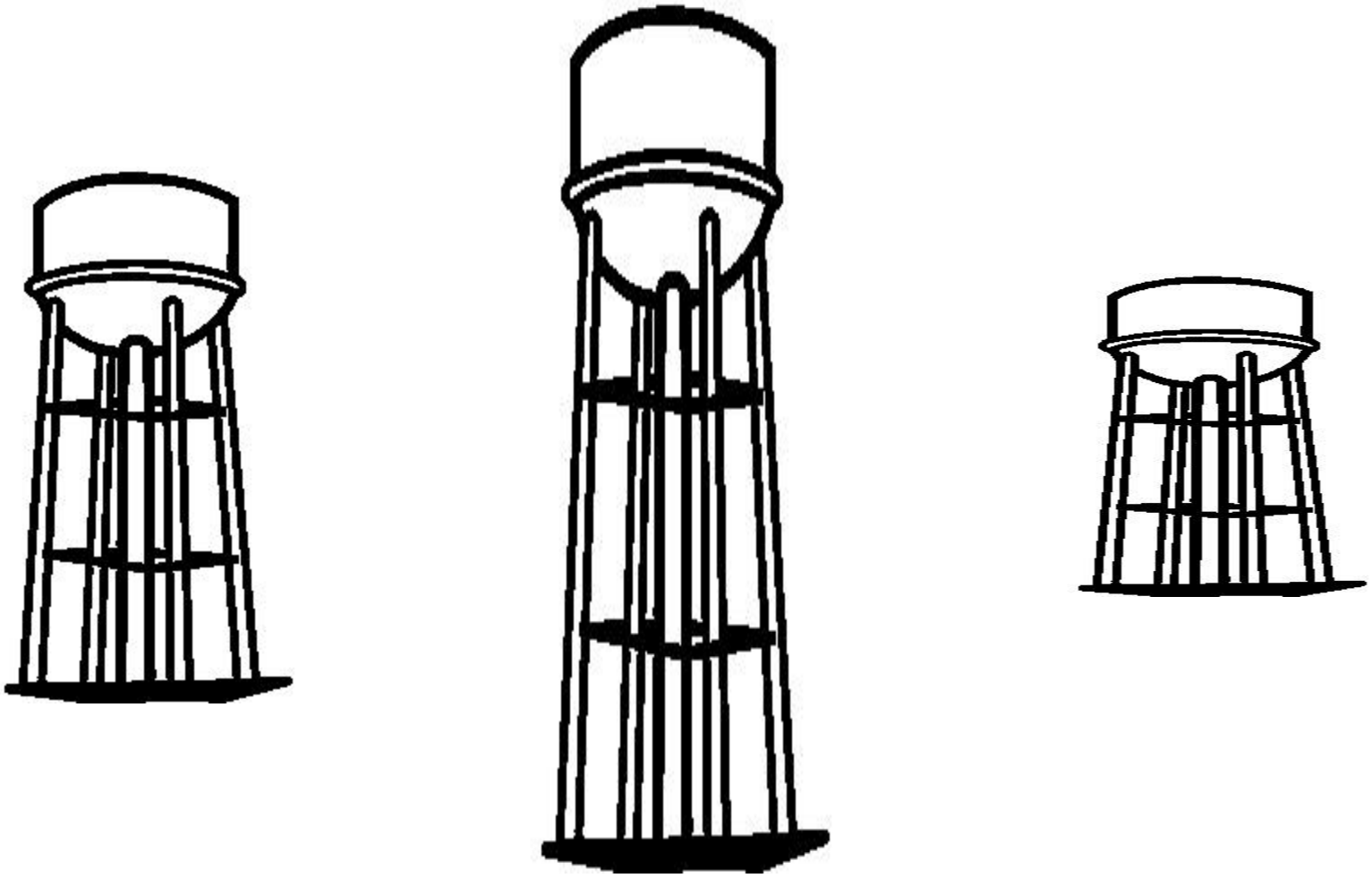


As the water flows out, the height of the water column drops, and the pressure drops along with it This will continue until all the water is gone.

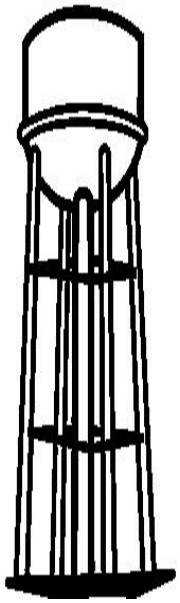
PSI	FEET
60	139
50	115
40	92
30	69
20	46
10	23
0	0

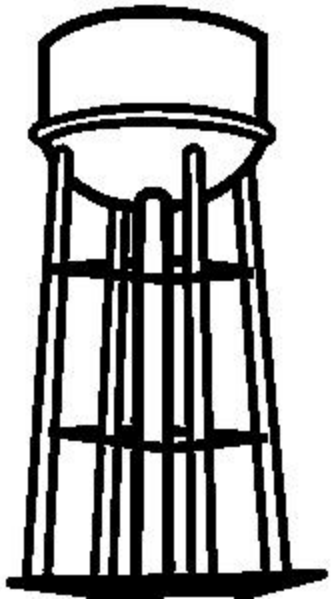
http://assolar.com/info/electricity-basics

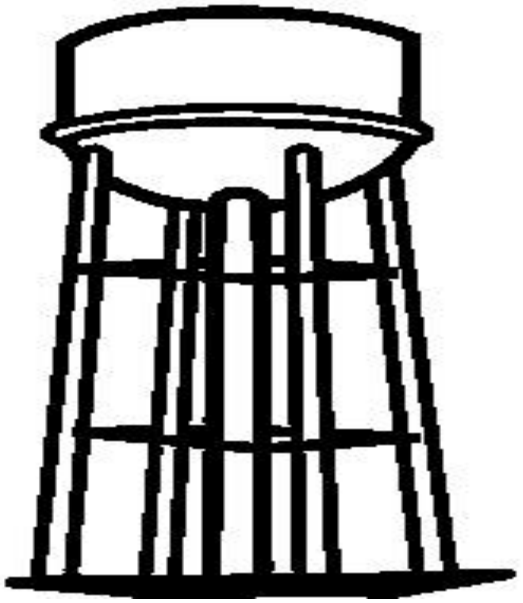
Which tower produces the greatest pressure?



Which tower produces the greatest pressure?







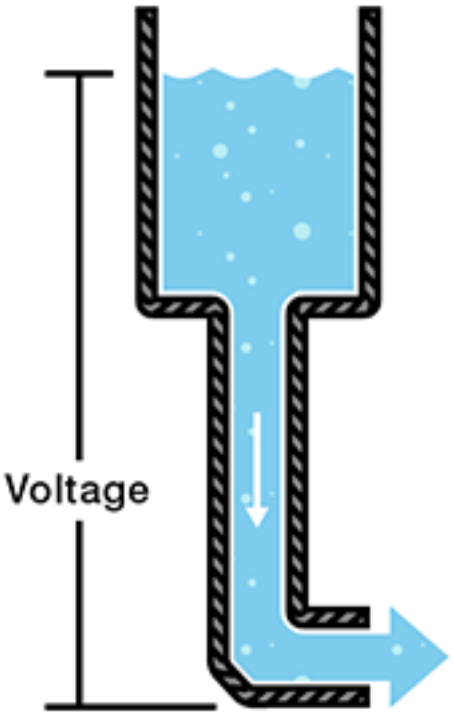
Investigate simple batteries and work on relating batteries to water towers. (Batteries with similar and different voltage!)

A. VOLTAGE

- Voltage = Potential Energy
  - **–electrical potential energy per unit charge**
    - Measured in Joules per Coulomb (J/C)
      - –or **Volts (V)**
    - **large** separation of charge creates **high** voltage
  - – the “push” or separation of charge causes electrons to move

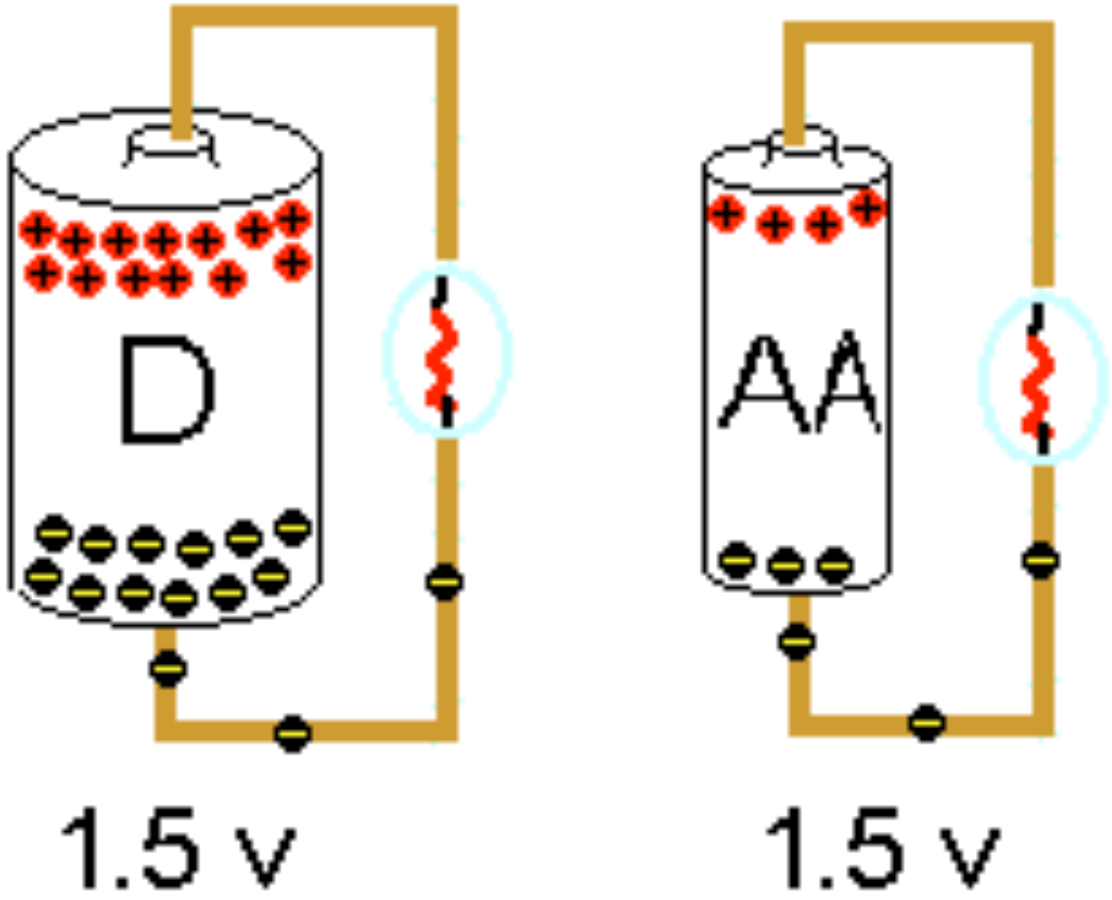
The height of the water in the tank determines how much potential energy there is.

The higher the water is in the tank, the more charge, and the more pressure is measured at the end of the hose.

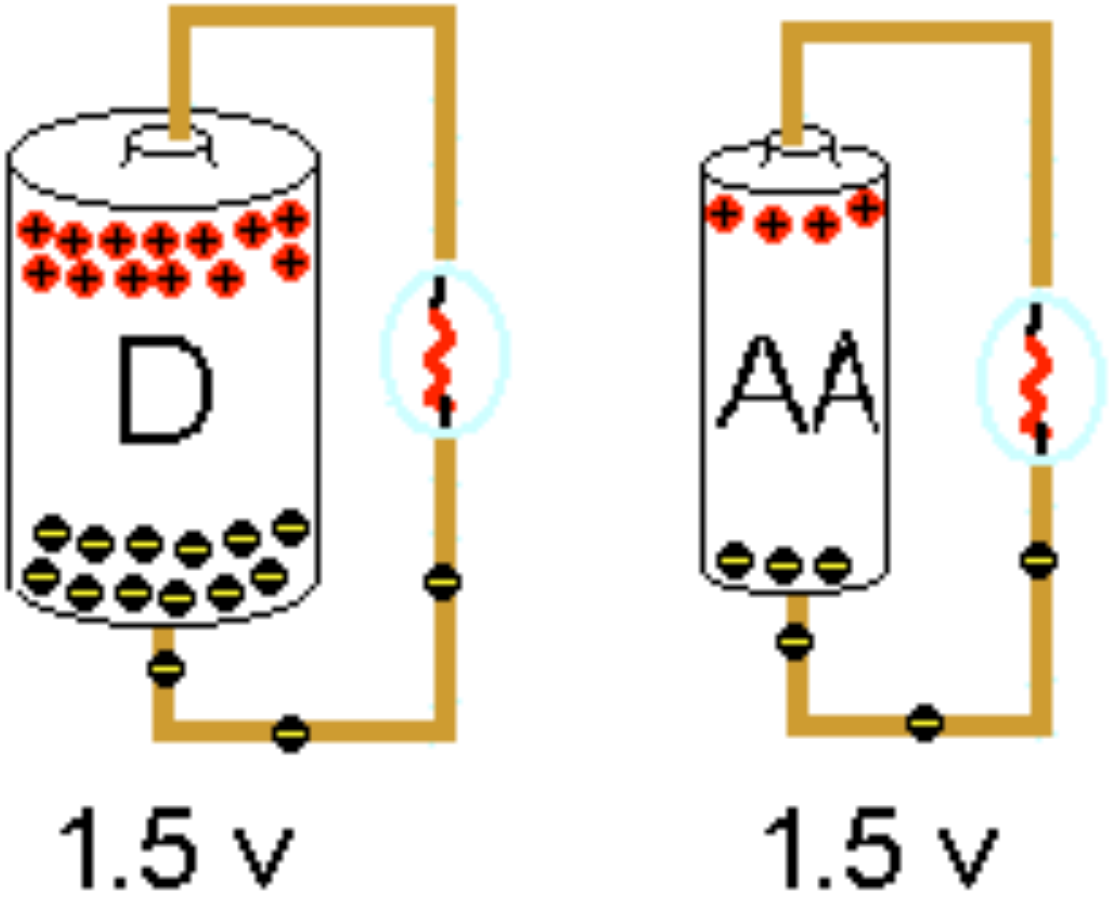


Think of a battery as a water tower, a place where we store a certain amount of energy and then release it. If we drain our tank a certain amount, the pressure created at the end of the hose goes down. We can think of this as decreasing voltage, like when a flashlight gets dimmer as the batteries run down.

The battery would stop producing voltage once the chemical reaction within the battery has run out. If both batteries are 1.5 volts, which battery will run out first?



The AA battery would need replaced first - in sticking with the water tower analogy, both batteries could hold water at the same height which would mean they have the same potential energy, but the AA battery can hold less water so it runs out faster!

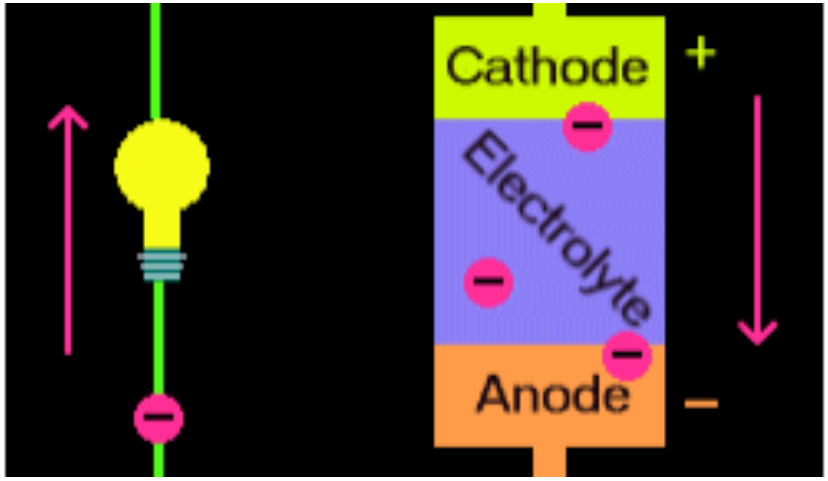


Batteries – chemical reactions

Batteries convert chemical energy to electrical energy

Batteries have three parts

1. an anode (-)
2. cathode (+)
3. the electrolyte

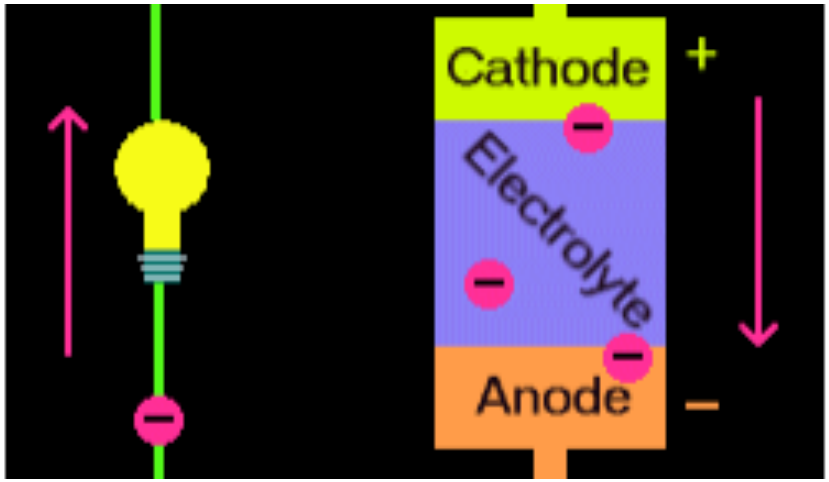


Cathode = Low potential energy
Anode = High potential energy

In battery **electrons** flow from **cathode to anode** **(gain energy)**
In circuit **electrons** flow from **anode to cathode** **(lose energy to electrical device)**

Batteries continued

The difference between high electric potential energy and low electric potential energy is called **voltage.**

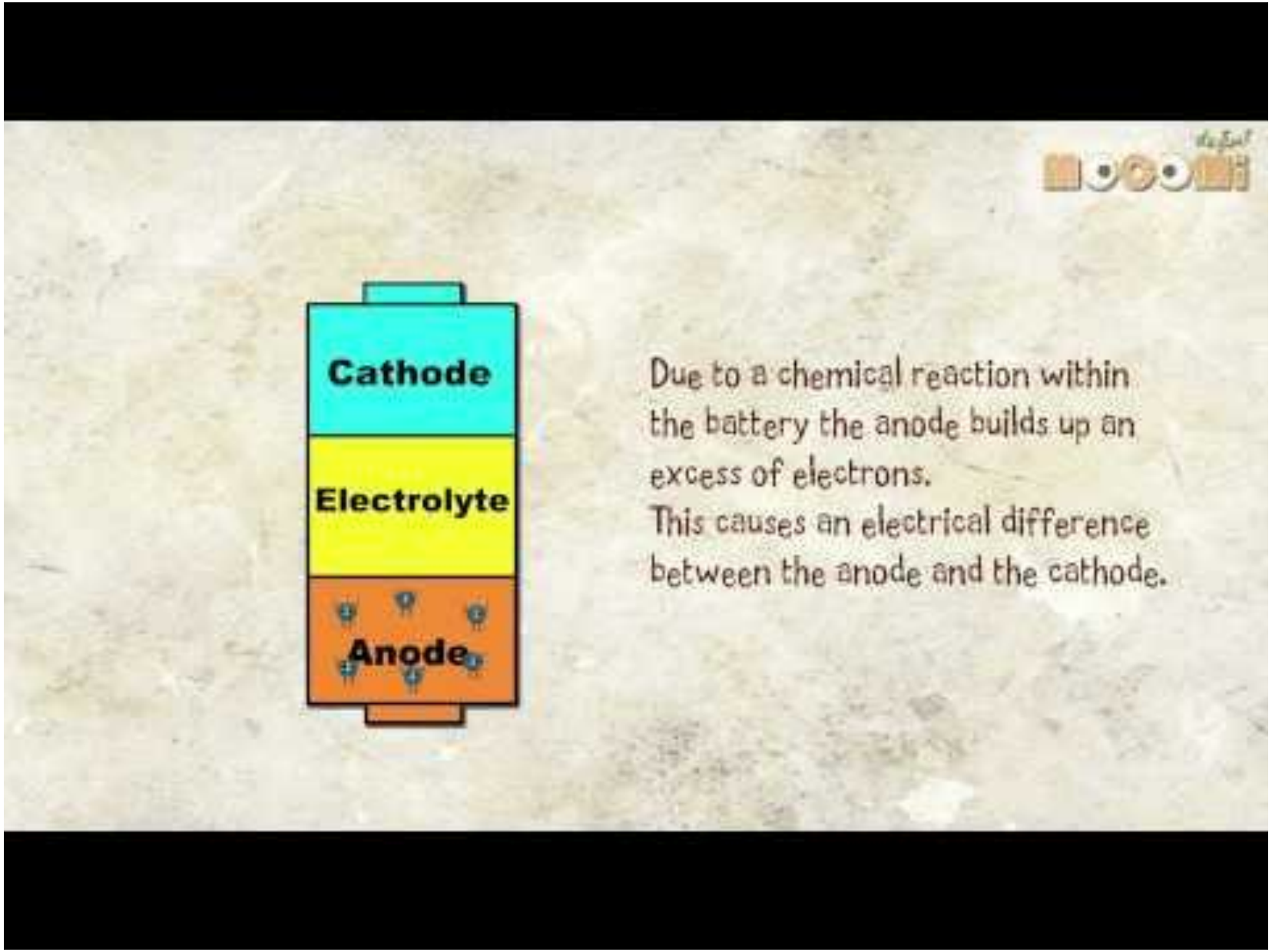


Chemical reactions in a battery causes a buildup of electrons at the anode. This results in difference of charge between the anode and the cathode.

Electrons repel each other because they have like charges (negative) and move towards the cathode through the circuit.

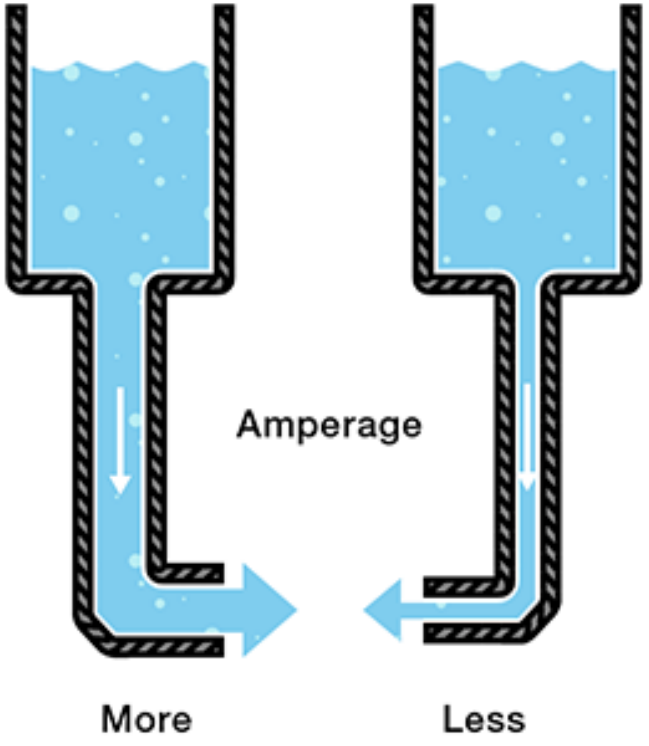
When the circuit is closed the electrons will be able move through the wire, lighting the light bulb along the way.

Watch Battery Video --- READ THE TEXT!!!!



B. CURRENT

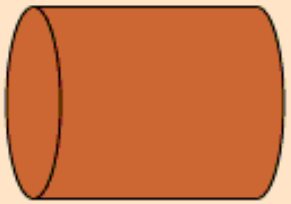
- **Current**
  - the number of electrons that flow through an area over a period of time
  - depends on # of electrons passing a point in a given time
  - measured in amperes (A)
  - or coulombs per second (charge / second)



Size of wire effects flow

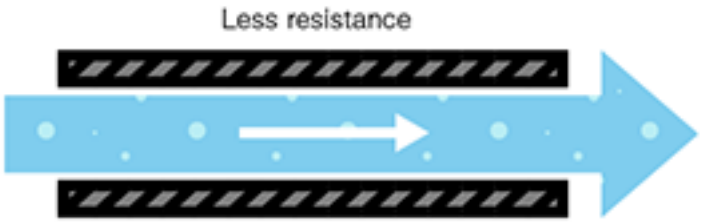
Volume flowrate in liters/min, cm^3/sec, m^3/sec, etc.

A large pipe offers very little resistance to flow, as shown by Poiseuille's law.

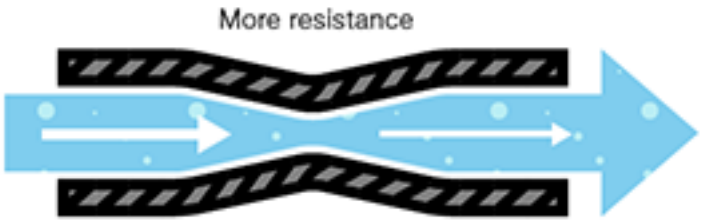


A wire offers very little resistance to charge flow according to Ohm's law.

Electric current flow in coulombs/sec = amperes.



= MORE FLOW!



= LESS FLOW!

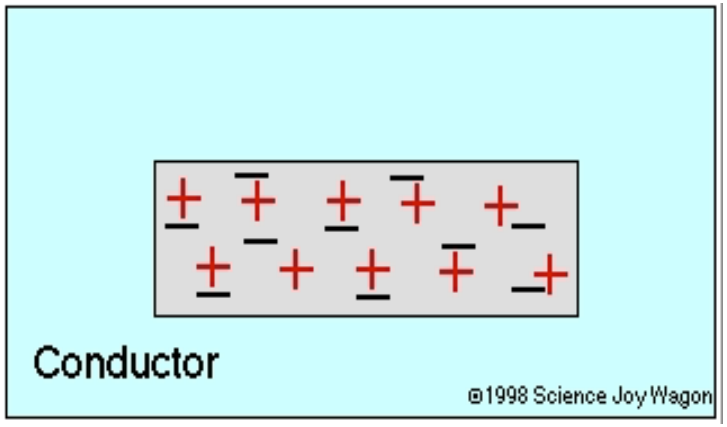
No current = no flow

A closed faucet has pressure behind it, but no flow.
(resistance → ∞)

A receptacle has voltage behind it, but no current if nothing is plugged in.
(resistance → ∞)

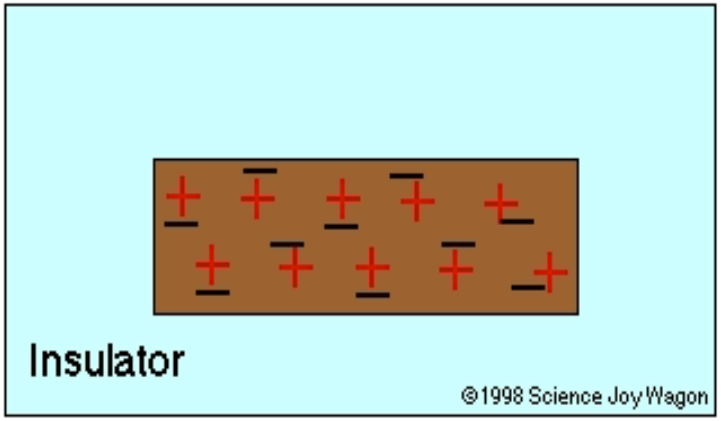
Materials: Can electrons easily flow through it?

- **<u>Conductor -- YES!</u>**
  - material that allows electrons to move through it easily
  - e^- are loosely held
  - <u>ex</u>: metals like copper and silver



Materials: Can electrons easily flow through it?

- **<u>Insulator -- NO!</u>**
  - material that doesn't allow electrons to move through it easily
  - e^- are tightly held
  - <u>ex</u>: plastic, wood, rubber, glass



C. Resistance

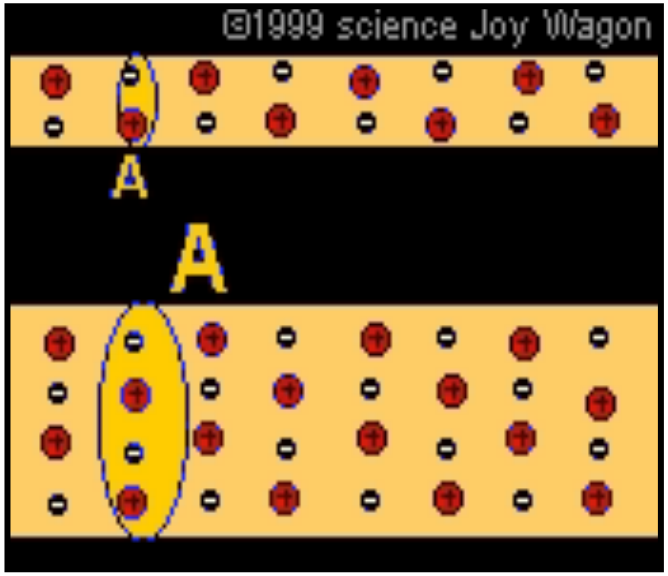
- **Resistance**
  - opposition the flow of electrons
  - electrical energy is converted to thermal energy & light
  - measured in ohms (Ω)

Copper - low resistance

Tungsten - high resistance

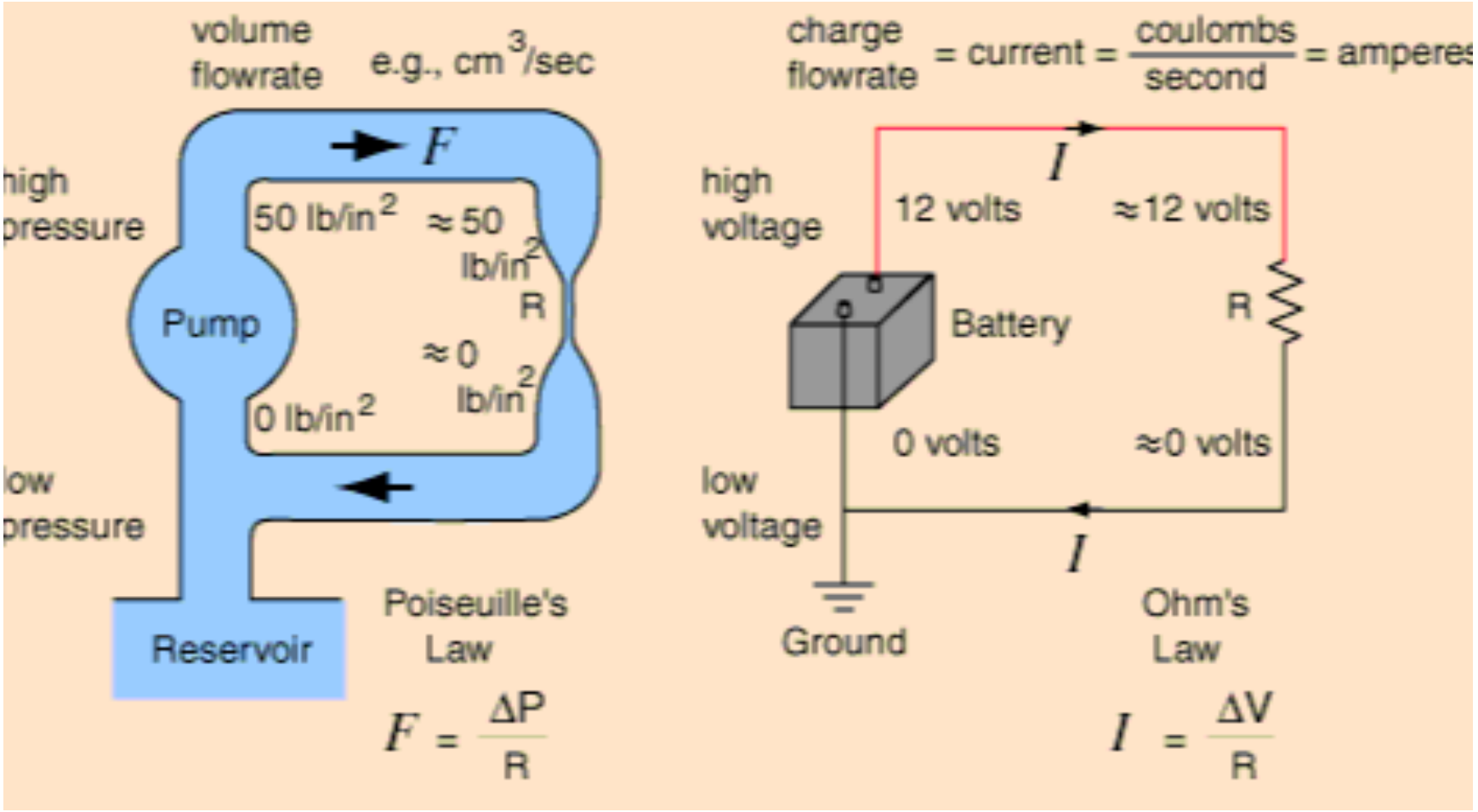
C. Resistance

- **Resistance depends on…**



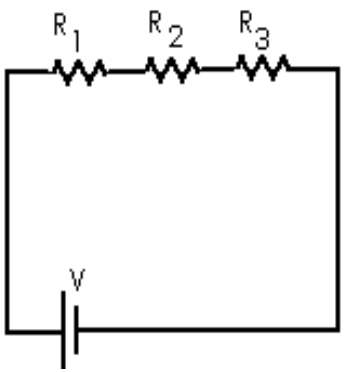
- The **material** that electrons are flowing through
  - wire **thickness**:
    - less resistance in thicker wires
  - wire **length**:
    - less resistance in shorter wires
  - **Temperature**: less resistance at low temps

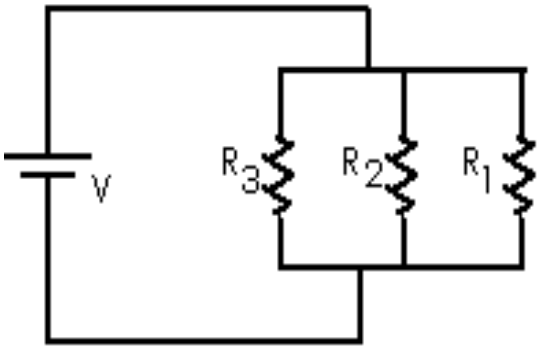
Less flow = more resistance



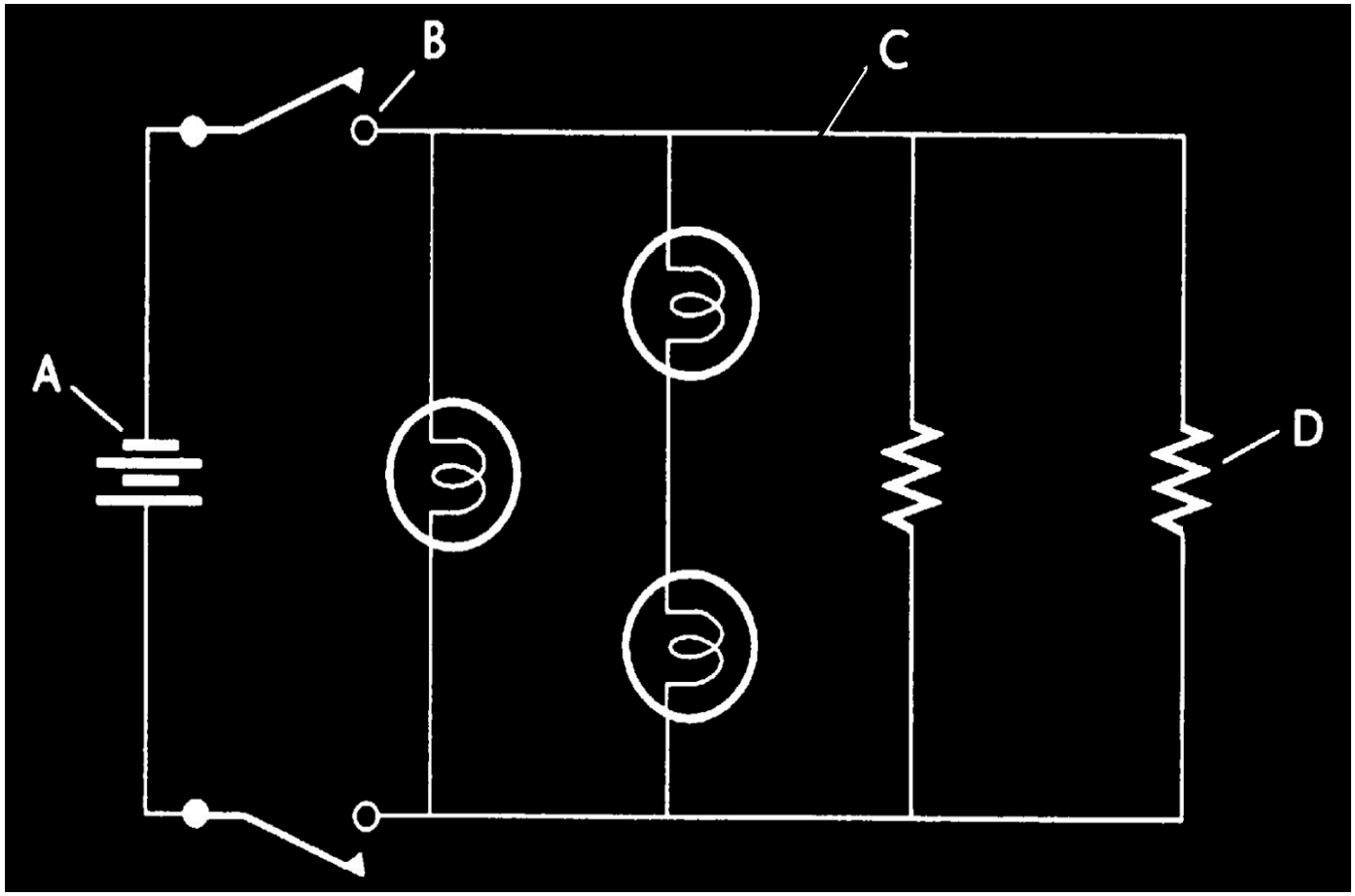
D.Circuit

- **Circuit**
  - When closed – it is path through which electrons can flow
  - When open – the path is incomplete and electrons cannot flow





Circuit Components



A - battery

C - light bulb

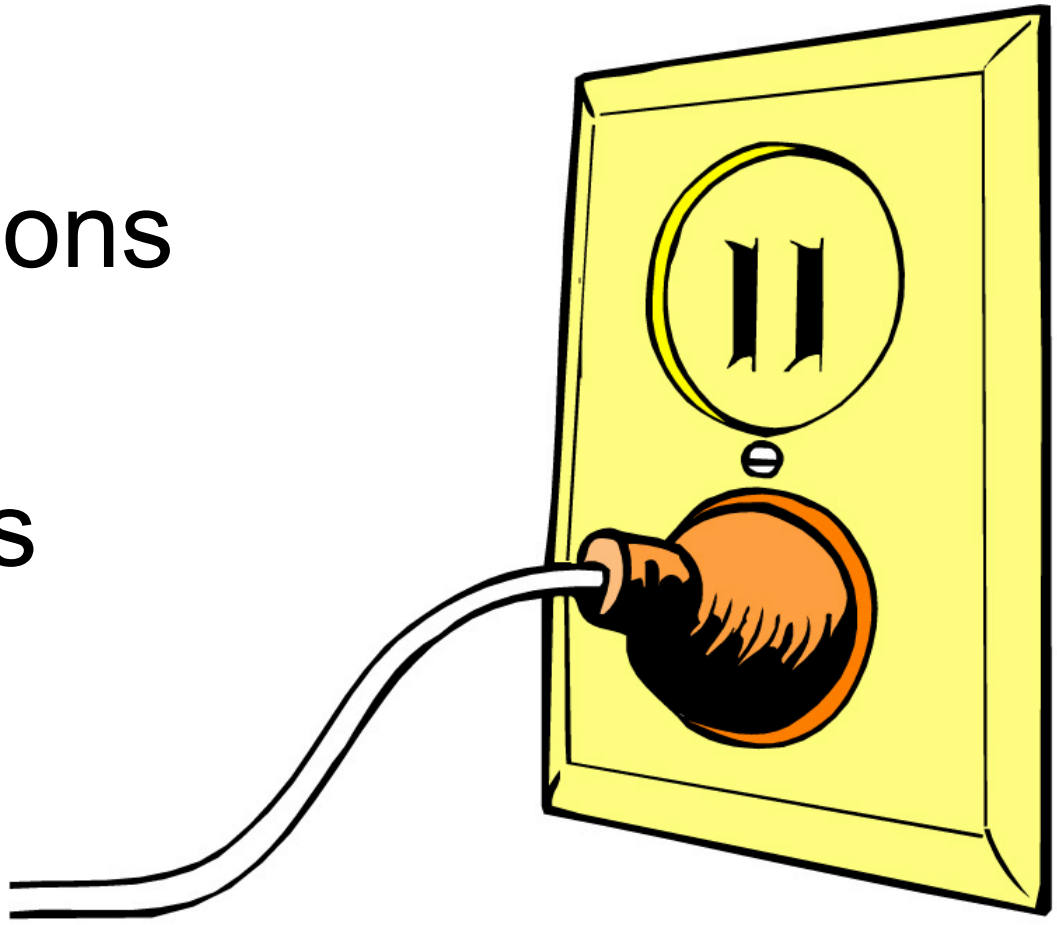
B - switch

D - resistor

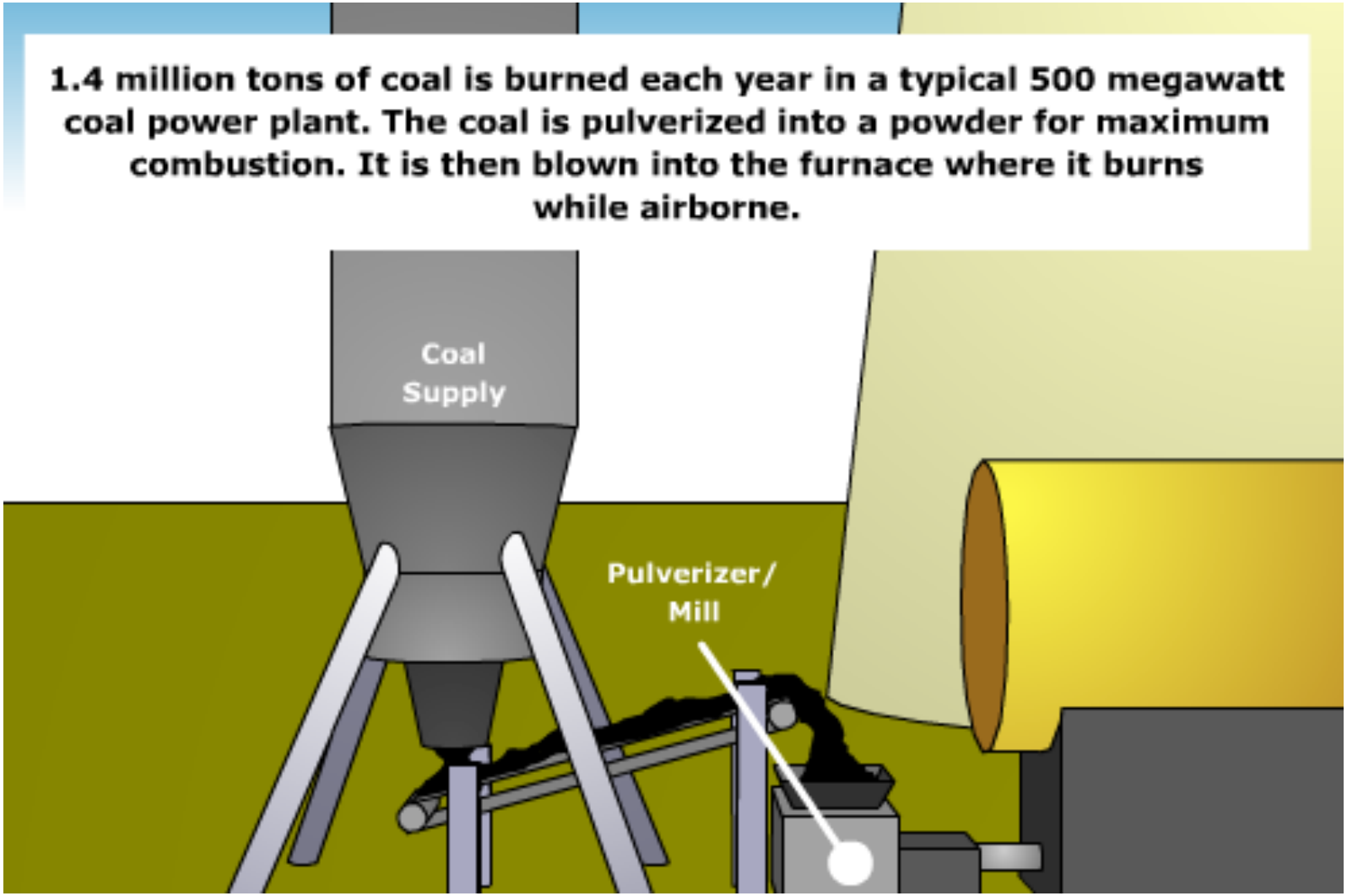
Electricity

Where does it come from?

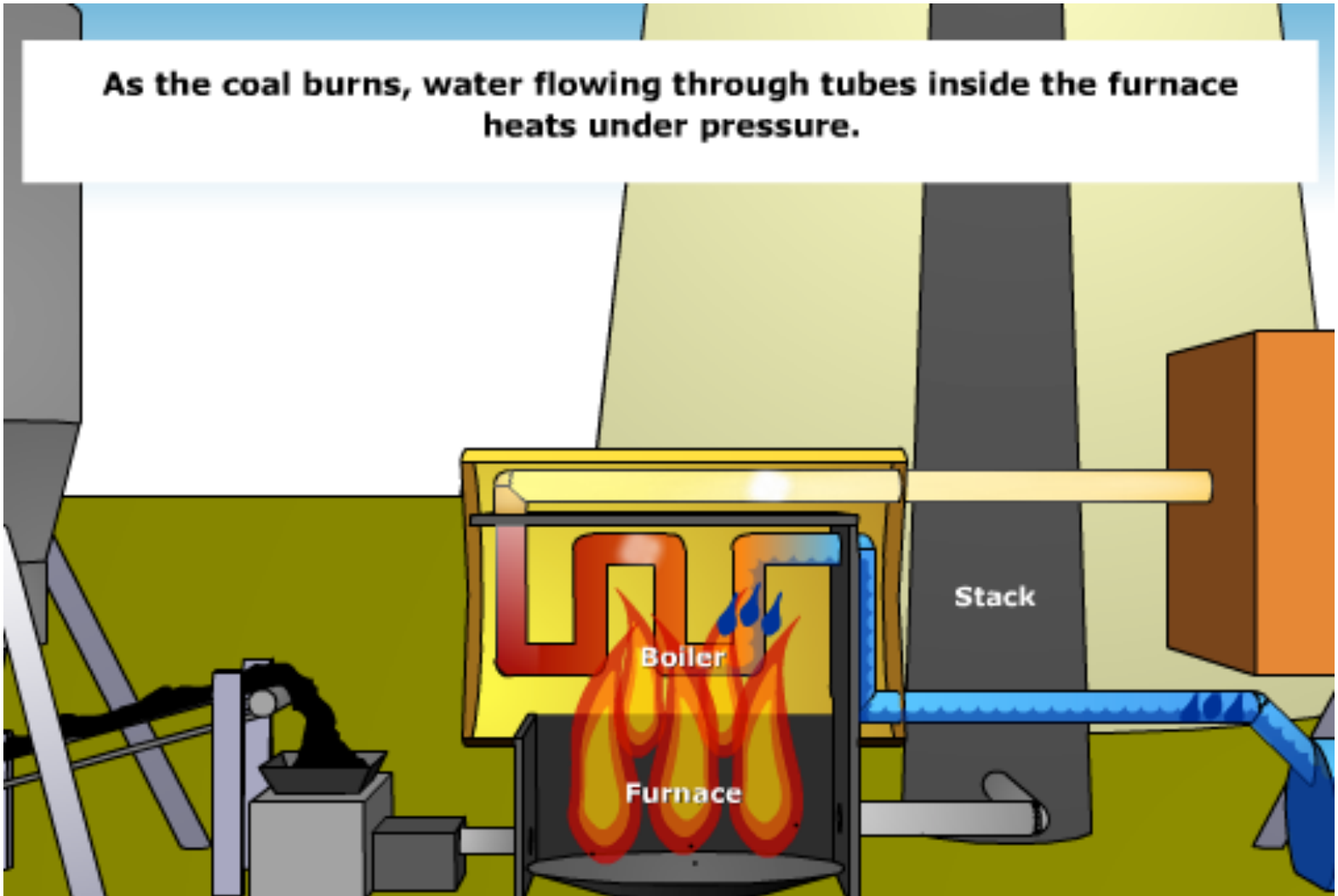
- Burning coal
- Nuclear reactions
- Wind turbines
- Water turbines
- Solar panels
- Batteries



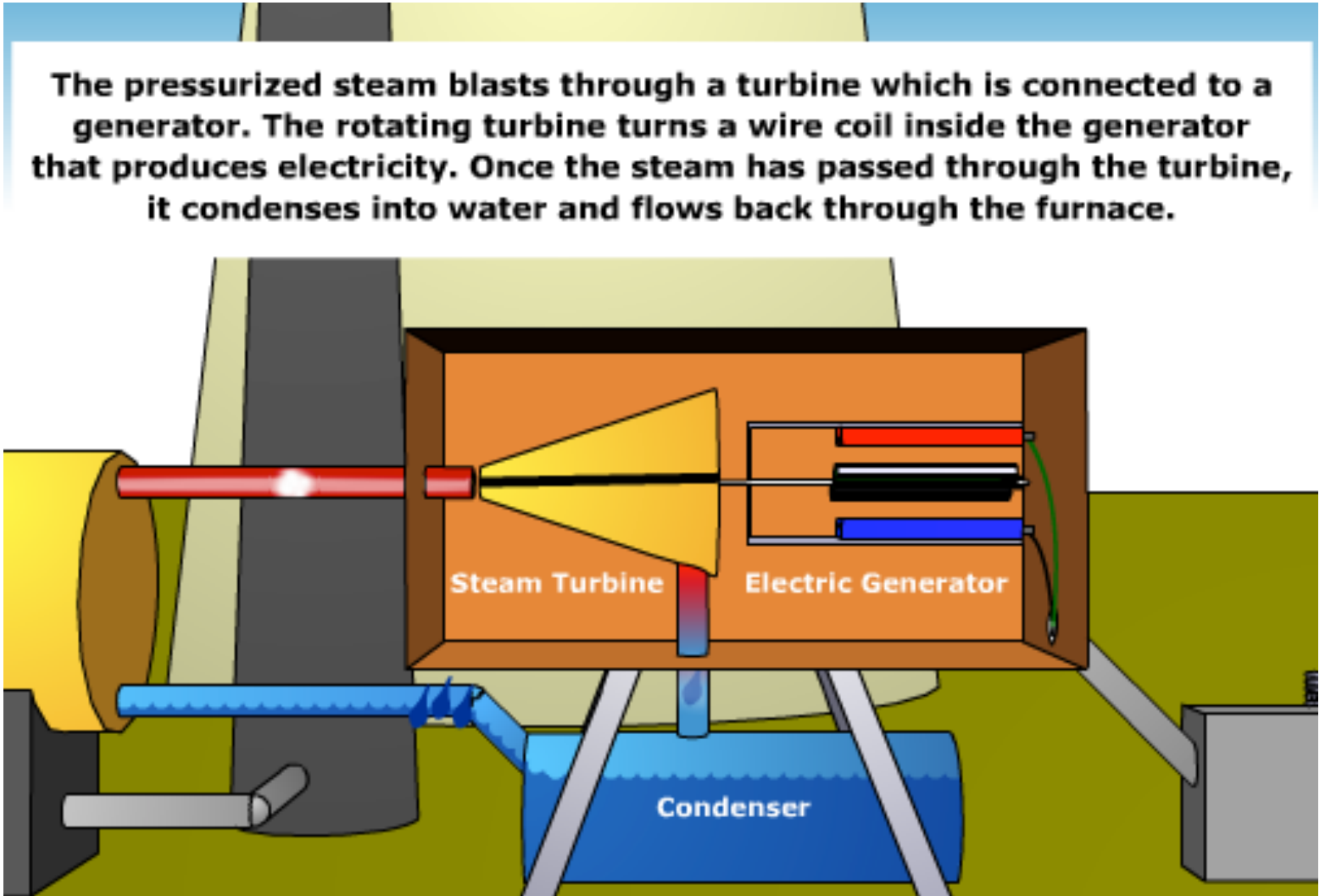
How can burning coal get us electricity?



Coal has energy stored in its chemical bonds, when it burns a large amount of heat is produced, this warms the water and the water turns to steam

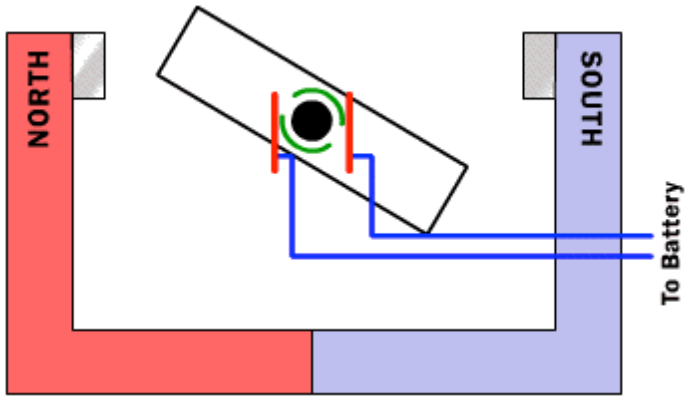


The steam causes a turbine to move, and that rotates a copper coil inside a generator turning mechanical energy into electrical energy

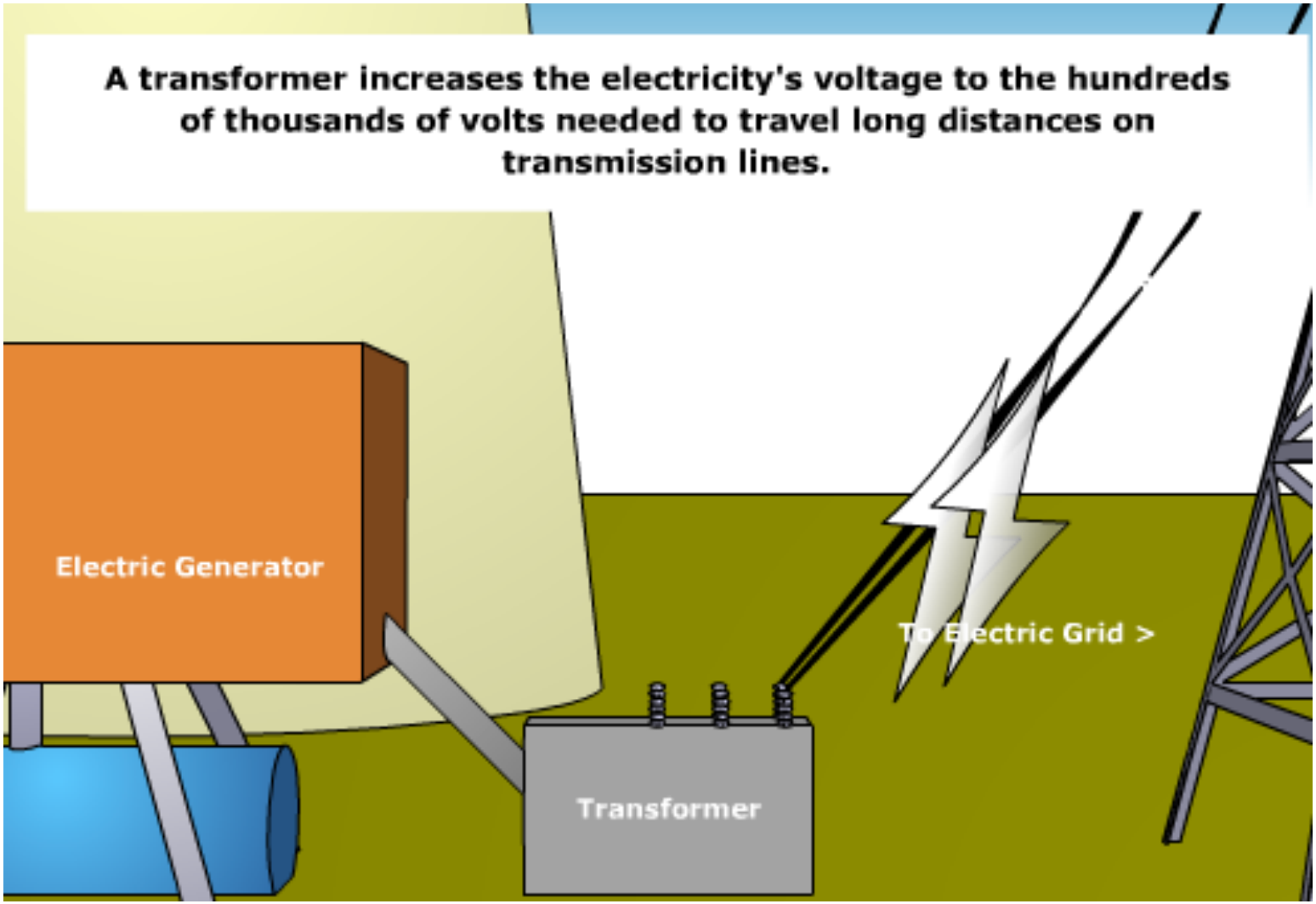


What is a generator?

- A device that moves a magnet near a wire to create an electrical current.
  - –Acts as a pump pushing water through a pipe.
  - –Instead of pushing water, a generator uses a magnet to push electrons along.



The electrical energy flows through wires and is used in homes and businesses



How about the other beginnings?

- **Nuclear reactions** – changes in the makeup of an atoms nucleus produces large amounts of heat energy – which heats water, produces steam, turns turbines, turns generators
- **Wind turbines** - mechanical energy from wind turns turbines which turn generators
- **Water turbines** – mechanical energy from water turns turbines which turn generators
- **Solar panels** – light energy / photons knock electrons free and allows them to flow